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REPORT

SUBJECT Soviet English-Language Manual Entitled Multiple-Range Portable Measuring Instrument, Type Ts-52

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THIS IS UNEVALUATED INFORMATION. SOURCE GRADINGS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

1. a 35-page, English-language manual entitled Multiple-Range Portable Measuring Instrument, Type Ts-52 . No publishing data were given.

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2. The Ts-52 measures current and voltage in DC and AC circuits with frequencies ranging from 45 to 1000 cycles per second, ohmic resistance, capacitance, transmission level, gain, and attenuation. It has special sets of accessories which include two voltage dividers, a shunt, and a current transformer which increases the range for measuring currents and voltages in both circuits.

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INFORMATION REPORT INFORMATION REPORT

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Attachment

MULTIPLE-RANGE PORTABLE
MEASURING INSTRUMENT
TYPE Ts-52

MULTPILE-RANGE PORTABLE

MEASURING INSTRUMENT

TYPF LI-52

MULTIPLE - RANGE

PORTABLE

MEASURING INSTRUMENT

TYPE 452

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I. APPLICATION

The Type 452 Multiple-Range Portable Measuring Instrument is designed to measure the following electrical values: current and voltage in d.c. circuits, and in a.c. circuits with frequencies ranging from 45 to 1000 cycles per sec., ohmic resistance, capacitance, transmission level, gain and attenuation.

This instrument can be used at ambient temperatures ranging from -10 to +40°C and relative humidity up to 80%.

The Type 452 instrument has been specially designed for radio and other weak current circuit measurements.

The low load requirements of this instrument allow measurements to be taken in the circuits without noticeable disturbance of their normal conditions of operation.

Special connecting leads with a set of removable connectors and probes with which the instrument is furnished, make it possible to carry out measurements at highly inaccessible points of intricate circuits and apparatus.

On request of the Purchaser, the Type 452 instruments are available with special sets of accessories.

The special sets include additional equipment comprising two voltage dividers; a shunt and a current transformer serving for broadening the range of measurement of currents and voltages in both d.c. and a.c. circuits.

Both sets of equipment are furnished in special metal cases designed to accomodate the instrument and its accessories. The cases have removable covers supplied with rubber gaskets and are fitted with handles for carrying.

II. [illegible] CHARACTERISTICS

This instrument conforms to all the requirement of U.S.S.R. Standard GOST 1845-52 relevant to instruments of the 4 service conditions group and of 1.5 class accuracy for d.c. instruments, and 2.5 class accuracy for a.c. instruments. The principal technical characteristics of the instrument are listed in Table 1 below.

Table 1

Item No.	Description	Values	Notes
1.	Upper limits of measurement of:	75 mV; 3 V; 7.5 V; 15 V; 30 V; 150 V; 300 V; 600 V; 7.5 kV	with Type P516 voltage divider
	a/ d.c. voltage		
	b/ a.c. voltage	3 V; 7.5 V; 15 V; 30 V; 150 V; 300 V; 600 V; 6.0 kV	with Type P515 voltage divider
	c/ d.c. current	150 microA; 3mA; 15mA; 60 mA; 0.3A; 1.5A; 6 A; 30 A	with type P514 shunt
	d/ a.c. current	3 mA; 15mA; 60mA; 0.3 A; 1.5A; 6 A; 30 A	with tipe M 501 current transformer
	e/ ohmic resistance	10 kiloohms; 100 kiloohms, 1 megohms; 10 megohms	
	f/ capacitance	10 mfd	
	g/ transmission level, attentuation, and gain	from -10 db up to +12 db	

Item No.	Description	Values	Notes
2	Basic error of instrument:		
	a/ for measurement of: d.c.voltages and currents	not over ±1.5%	in per cent of full scale value
	b/ for measurements of a.c. voltages and current	not over ±2.5%	
	c/ for measurements of ohmic resistance	not over ±1.5%	in per cent of scale length
	d/ for capacitance measurements	not over ±2.5%	in per cent of scale length
	e/ for transmission level, attenuation and gain measurements	not over ±2.5%	in per cent of scale length
3	Load requirements of instrument:		
	a/ current of full scale deflection for d.c. voltage measurements on ranges: 75 mV; 3; 7.5; 15; 30;30; 150;300 and 600 volts;	50 micro A	
	on 7.5 kV range	51.2 micro A	
	b/ current of full scale deflection for a.c. voltage measurements on ranges 15,30,150,300 and 600 volts;	0.5 mA	
	on 6 kV range	0.512 mA	

Item No.	Description	Values	Notes
	c/ current of full scale deflection for a.c. voltages on 3 and 7.5 V ranges	1 mA	
	d/ drop in voltage on instrument terminals when measuring d.c. current on 150 microA to 1.5 A ranges.	not over 0.4 V	
	ditto, on shunt terminals for measurements on 6 and 30 A ranges	75 mV	
	e/ drop in voltage on instrument terminals when measuring a.c. currents on 3 mA to 1.5 ranges	not over 1.5 V	
	ditto, on transformer terminals for measurements on 6 and 30 A ranges	not over 0.1 V	
4	Damping time	not over 4 sec.	
5	Scale length /max./	85 mm	
6.	Test voltage for insulation of electrical circuits with respect to casing	50-cycles, 2 kVeff.	

Item No.	Description	Values	Notes
7	Overall dimensions of instrument	110 x 205 x 80 mm	
8	Weight of instrument	not over 1.3 kg	
9	Overall dimensions of carrying case /normal set of accessories/	230 x 200 x 100 mm	
10	Weight of instrument, carrying case and accessories /normal set of accessories/	not over 2.7 kg	
11	Overall dimensions of carrying case /special set of accessories/	330 x 295 c 100 mm	
12	Weight of instrument, carrying case and accessories /special set of accessories/	not over 4.7 kg	

The basic errors of the instrument will not be exceeded when it is employed under normal operating conditions, without the voltage divider, shunt and transformer.

Normal conditions for these instruments are:

a/ horizontal positioning of the instrument;

b/ ambient temperature +20 ±5°C.

c/ for all measurements of a.c. current and voltage at frequencies between 45 and 500 cycles per sec., on all the ranges, with the exception of the 600 V range, and at fre-

quencies between 45 and 200 cycles per sec. on the 600 V range, the wave form of the current and voltage is to be sinusoidal, i.e., any instantaneous value of the current or voltage should not differ from the corresponding instantaneous value of the first harmonic by more than ±2% of the first harmonic amplitude.

Under conditions of operation other than normal the readings of the instrument may suffer a change.

a/ The change in the readings of the instrument, on any range of measurement, due to changes in ambient temperature from +20±5°C to any temperature between limits of -10° and +40°C, will not exceed the basic error values given in Table 1 for each 10°C change in temperature and each corresponding range of measurement.

b/ For measurements of a.c. current and voltage in a region of frequencies beyond those given above, the changes in the readings will not exceed ±2.5% of full scale value under the following changes in frequency:

1/ up to 1000 c.p.s. - on all ranges of measurement of a.c. voltages and currents with the exception of the 600-volt range.

2/ up to 500 c.p.s. - on the 600-V a.c. voltage range.

a/ The change in the readings of the instrument due to the influence of an external magnetic field of 5-oersted strength produced by a direct current or a 50-cycle alternating current will not exceed ±1% of full scale value. The instrument, when connected as an ohmmeter, microfaradmeter or a transmission-level measuring device, will give, under these conditions, readings which are not changed by more than ±1%

of scale length for the corresponding scales.

*/ The change in the readings of the instrument due to an inclination of 10 deg. from the normal /horizontal/ position in any direction will not exceed ±1.5% of scale length.

When the instrument is connected to a voltage divider, shunt or current transformer, the errors of the accessories are added to the basic errors of the instrument.

For measurements of resistance on the 10-kiloohm, 100-kiloohm and 1 megohm ranges, a 1,5 V type E3-0.25 dry cell installed inside the instrument serves as the source of supply. The maximum current drown from the dry cell is equal to 7.5 mA.

To measure resistances on the 10-megohm range, an external d.c. source rated for 18 volts is necessary. The maximum current drown from supply equals 0.09 mA.

For capacitance measurements, an external 50-cycle, 220-volt source of a.c. is required. The maximum current drawn from supply equals 15 mA.

III. VOLUME OF DELIVERY

The L52 Instrument is shipped complete with a normal or special set of accessories.

Normal set volume

1. Type L52 instrument	1 pc.
2. Type E3-0.25, 1.5 V dry cell, built in	1 pc.
3. Connection lead with connectors, one-metre length	2 pcs.
4. Flat removable lead connector	2 pcs.
5. Alligator terminal clips	2 pcs.

6. Removable probe	2 pcs.
7. Description and operating instructions. . .	1 copy
8. Instrument certificate.	1 copy
9. Carrying case for instrument and accessories	1 pc.

Special set volume

1. Type M52 instrument	1 pc.
2. Type RB-0.25 1.5 V dry cell, built in . .	1 pc.
3. Connection lead with connectors, one-metre length. . . .	2 pcs.
4. Flat removable lead connector	2 pcs.
5. Alligator terminal clips	2 pcs.
6. Removable probe	2 pcs.
7. Separate, type P-515 voltage divider rated for 6 kV a.c.	1 pc.
8. Separate, type P-516 voltage divider rated for 7.5 kV a.c.	1 pc.
9. Type M501 current transformer, rated for 6 and 30 A a.c.	1 pc.
10. Separate, calibrated type P-514 shunt, rated for 6 and 30 A, 75 mV, d.c. . .	1 pc.
11. Description and operating instructions. . .	1 copy
12. Certificate	1 copy
13. Carrying case for instrument and accessories	1 pc.

Note: The instrument will be shipped with the special set of accessories only on special request of the Purchaser.

IV. GUARANTEE

The period of guarantee of these instruments is equal to to 18 months from the date of shipment from the Marker's Works. The instrument, when employed under normal conditions of operation during this period of time, is to satisfy all the technical requirements specified for type U52 portable multiple-scale instruments and also required by U.S.S.R. Standard ГОСТ 1845-52.

V. PREPARATION OF INSTRUMENT FOR OPERATION AND GENERAL OPERATING DIRECTIONS

To obtain correct results when taking measurements and to protect the instrument from damage observe the following directions:

a/ before taking readings place the instrument in a horizontal position;

b/ set the pointer of the instrument to the initial scale division with the aid of the zero corrector.

c/ set the operation-mode switch to one of two positions:

"Ω" - for measurement of direct currents and voltages, and also resistances.

"μF" - for measurement of alternating currents and voltages, capacitances, attenuations and transmission levels;

d/ set the range-selector switch in the zero position.

When the magnitude of the current or voltage is questionable,

start taking the measurement on a maximum range and then change down to the most suitable range.

Do not operate the switch when the instrument is carrying a current, especially when measuring currents of considerable magnitude in high voltage circuits, as failure to observe this way lead to damage of the instrument as a result of burning of the switch contacts.

Switching over of the ranges with a current flowing when measuring voltages is relatively safe for the instrument; the same applies to switch-over of the ranges when measuring small currents /up to 50 mA/ in circuits of relatively low voltage /100-200 V/ and when switching is done during the measurement of resistance on the x1; x10 and x100 ranges.

It is absolutely imperative that the instrument be switched off prior to transfer from one kind of measurement to another, for example, when changing over from voltage to current measurements, from capacitance measurements to resistance measurements, etc.

e/ On completion of the measurements it is desirable that the range-selector switch be set to the "600-B" /600-V/ position. This safeguards the instrument against disastrous damage in a great many cases, again focussing attention upon the positions of the switches on the instrument.

Connection of the instrument to an electrical circuit for the taking of measurements is to be accomplished by means of the connection leads with removable connectors, removable alligator clips and attachable probes furnished with the instrument.

The connection leads leads are connected to the instrument by jack plugs or by removable flat connectors slipped over the plugs. Removable flat connectors are to be slipped over the ends of the leads to be attached to the circuit for the taking of measurements. Alligator clips are to be attached to the ends of the leads whenever it is desirable to maintain the contact for a longer interval of time. For momentary or short time contacts detachable probes are to be slipped on the ends of the leads.

When measurements are to be taken with a separate voltage divider, it is connected to the L-52 instrument with the aid of its own leads.

A removable connector, clip or attachable probe, of necessity, can be fitted on the connector of the separate voltage divider.

In taking measurements with the aid of a voltage divider, take care to observe all safety regulations relevant to working with high voltages.

In particular, reliably ground the "⏚" terminal of the voltage divider.

The voltage divider is to be grasped only at the broad part of the body up to the guard shoulder without coming into contact with the connector. Neither is it allowable to touch the terminals of the instrument.

Below is given a description of the various measurements which may be taken with the type L-52 instrument. All operations are to be carried out in the order given in the text.

VI. USE OF THE INSTRUMENT

1. Current and voltage measurements

Set the operation-mode and range-selector switches as instructed above.

The two terminals marked "-" and "+" are to be used for the measurement of d.c. and a.c. currents and voltages on all ranges of the instrument /the marking "Ω ≂" is located between these terminals/.

The readings of the value under measurement are to be taken on the accordingly marked scales.

2. Special cases of current and voltage measurements

a/ Measurement of direct current on 6 and 30 A ranges with a separate type P-514 shunt.

Plug the shunt, with the aid of its prongs, into the jacks of the "-" and "+" terminals of the instrument.

Set the switches on the instrument to positions corresponding to the measurement of a 75 mV d.c. voltage.

The current under measurement is then passed through the shunt at the "-" and "6A" terminals /6A range/ or at the "-" and "30A" terminals /30A range/.

b/ Measurement of alternating current on 6 and 30A ranges with a separate type M-501 current transformer.

Connect the current transformer terminals "15 mA" to the "-" and "+" terminals of the instrument.

Set the switches of the instrument to positions corresponding to the measurement of a 15 mA alternating current.

The current under measurement is passed through the current transformer at the terminals "✳" and "6A" /6A range/ or at the terminals "✳" and "30A" /30 A range/.

c/ Measurement of a d.c. voltage on the 7500 volt range with a separate type P-516 voltage divider.

The type P-516 voltage divider, enclosed in a moulded plastic casing, has two connection leads for connection to the instrument, the lead connectors being marked with the numbers "0" and "1". To the circuit under test the voltage divider is connected by means of terminal ⏚ on the "0" lead and a metal connector. Terminal ⏚ on the "0" lead is intended for attachment to that part of the circuit under measurement which is either grounded or the grounding of which is permissible. In the latter case the ⏚ terminal of the voltage divider is grounded in advance.

It is not permissible to take the measurements when one of the two points of an electrical circuit across which the voltage is to be measured is not grounded, or when grounding of these points is not allowable.

The connectors "0" and "1" of the voltage divider leads are to be connected to the "-" and "+" terminals of the instrument so that, when the minus side of the circuit under test is grounded, the "C" connector of the voltage divider is connected to the "-" terminal and, when the plus side is grounded, to the "+" terminal of the instrument.

Set the switches of the instrument to the position corresponding to the measurement of a d.c. voltage of 15 V.

Only after all the above directions for connection of

the leads and operation of the switches have been fulfilled, the metal connector can be attached to the second point of the circuit under test.

When measuring high voltages observe all acting safety regulations.

The voltage divider is to be grasped only at the broad part of the body up to the guard shoulder and without coming into contact with the connector.

d/ Measurement of a.c. voltage on 6000 V range with a separate type P-515 voltage divider.

The type P-515 voltage divider, similar to the type P-516, is enclosed in a moulded plastic casing and is provided with two leads, the connectors of which are marked with the numbers "0" and "1". To the circuit under test the voltage divider is connected by means of terminal "⏚" on the "0" lead and a metal connector.

The ⏚ terminal on the "0" lead is intended for attachment to that part of the circuit under measurement which is either grounded or the grounding of which is allowable.

In the latter case the "⏚" terminal of the voltage divider is to be grounded in advance.

It is not permissible to take measurements on one of the two points of an electrical circuit across which the voltage is to be measured if the circuit is not grounded or does not permit grounding.

The voltage divider lead connectors marked "0" and "1" are respectively connected to terminals "-" and "+" on

the instrument.

Set the switches on the instrument to the positions corresponding to the measurement of an a.c. voltage of 15 V.

Only after all the above directions for connection of the leads and operation of the switches have been fulfilled,

The metal connector can be attached to the second point of the circuit under measurement.

When taking measurements at high voltages observe all acting safety regulations.

The voltage divider is to be grasped only at the broad part of the body up to the guard shoulder and without coming into contact with the connector.

e/ Measurement of an a.c. voltage with a superimposed d.c. voltage.

Set the switches on the instrument into the positions employed for measuring a.c. voltages. The voltage under measurement is to be applied to terminals "-" and "μF".

In such cases a 0.2 mfd capacitor is connected to pass through.

The voltage of the d.c. component is not to exceed 400 V /i.e. not to exceed the rated working voltage of the capacitor/.

The change in the readings of the instrument due to the capacitive reactance of the capacitor will be less than 1% if the product of the frequency /in c.p.s./ and the full value of the selected range /in volts/ is over 3000 for all ranges beginning with the 15-V range and upward.

3. Measurement of ohmic resistances

a/ Measurements on the 10 kiloohm, 100 kiloohm and 1 megohm ranges. A dry cell installed within the instrument serves as the source of power supply.

Set the operation-mode switch to the "Ω" position.

Set the range-selector switch to the "KΩx1", "KΩx10" or "KΩx100" range in accordance with the expected value of the resistance. Solidly short terminals "-" and "+" of the instrument across each other and by turning the "zero-ohms corrector" knob set the pointer of the instrument to the zero division on the "KΩ" scale /if this setting is unattainable, replace the type ФБС-0.25 dry cell installed in the instrument with a new cell or one of similar dimensions. The range of adjustment of the "zero-ohms corrector" knob is designed for a dry cell voltage ranging from 1.25 to 1.63 volts.

Remove the jumper on the "-" and "+" terminals of the instrument and connect them to the resistance subjected to measurement. Take the readings of the measured resistance on the "KΩ" scale.

b/ Measurements on the 10 megohm scale.

An external battery with a voltage of 15.5 to 19.5 volts is to serve as the source of supply.

Set the operation-mode switch to the "Ω" position and the range-selector switch to the "KΩx1000" position. Connect the battery to the "-" and "+" terminals of the instrument /with observance of the polarity/. By turning the "zero-ohms corrector" knob, set the instrument pointer

to zero on the "KΩμF" scale. Disconnect one pole of the battery from the instrument terminal and connect the resistance subject to measurement between the pole of the battery and the instrument terminal.

Take the readings on the "KΩμF" scale directly in megohms.

4. Capacitance measurements

A 50-cycle a.c. circuit with a voltage of 190 to 240 volts is to be used as the source of supply.

Set the operation-mode switch to the "μF" position and the range-selector switch to the "μF" position.

Connect the supply circuit to the "-" and "+" terminals of the instrument. Turn the "zero-ohm corrector" knob to set the pointer to zero on the "KΩμF" scale.

The capacitance under measurement is to be connected to terminals "-" and "μF" of the instrument.

The readings are taken on the "KΩμF" scale directly in microfarads.

When capacitances of low value /of the order 5000 to 10000 picofarads/ are being measured, almost full supply circuit voltage is applied to the capacitor. When large capacitances are measured the voltage on the capacitor under measurement is reduced.

Shorting of terminals "-" and "μF" /for example, on breakdown of the capacitor under measurement/ is not dangerous for the instrument.

5. Measurement of transmission level

The value of a transmission level is characterized by the logarithm of the ratio between a voltage U_2 on a given load, or the input P_2 consumed by a given load and a voltage U_0 or input P_0, respectively taken as reference values.

Voltage-ratio transmission level $P_H = 20 \log \frac{U_2}{U_0}$ db

Power ratio transmission level $P_H = 10 \log \frac{P_2}{P_0}$ db

Depending upon the selected reference values, transmission level is defined as absolute or relative.

If a voltage $U_0 = 0.775$ V or power $P_0 = 1$ milliwatt are taken as reference values, the corresponding transmission levels are considered as absolute.

Absolute voltage-ratio transmission level

$$P_{AH/rv/} = 20 \log \frac{U_2}{0.775} \text{ db}$$

Absolute power-ratio transmission level

$$P_{AH/rp/} = 10 \log \frac{P_2}{0.001} \text{ db}$$

The corresponding transmission levels are termed as relative when the assumed reference values correspond to the voltage or power at some other point in a circuit, for example the voltage U_1 on the inputs of the device or circuit under test /at the outputs of which a given load is carried/ or the power P_1 fed in at the inputs.

Relative voltage-ratio transmission level

$$P_{OH/rv/} = 20 \log \frac{U_2}{U_1} \text{ db}$$

$$P_{OU}{}_{/rp/} = 10 \log \frac{P_2}{P_1} \quad db$$

From the above relations it is evident that the relative transmission level between two points, 1 and 2, of a circuit is equal to the difference in absolute levels between these points.

a/ Measurement of $P_{AH}{}_{/av/}$ - absolute voltage-ratio transmission level.

The decibel scale on the I52 instrument is so graduated that zero on the scale corresponds to a voltage of 0.775V.

Readings on the decibel scale marked "db" thus give direct absolute voltage-ratio transmission level readings.

To obtain absolute voltage-ratio transmission level readings, set the operation-mode switch to the "~" position and the range-selector switch to the "3V" or "7.5 V" range position in accordance with the voltage across the circuit section under test.

Connect the instrument to the circuit at terminals "-" and "+".

Take the readings on the "db" scale, the absolute voltage-ratio transmission being equal to the reading on the "3 V" scale. When taken on the 7.5 V scale, the reading is to be increased by 8 db.

It is to be borne in mind that the resistance of the instrument on the "3 V" range is equal to 3000 ohms, on the 7.5 V range it is 7500 ohms.

The measurement can be taken only when the insertion of such resistance values into the circuit does not greatly affect normal circuit conditions.

b/ Measurement of $P_{OH/rv/}$-relative voltage-ratio transmission level.

The relative voltage-ratio transmission level $P_{OH/rv/}$ between two points 1 and 2 in a circuit is equal to the difference between the absolute transmission levels P_{AH_2} and P_{AH_1} at each of these points:

$$P_{OH} = P_{AH_2} - P_{AH_1}$$

The absolute transmission levels P_{AH_2} and P_{AH_1} at points 1 and 2 are to be obtained as directed above.

c/ Measurement of P_{AM} - absolute power-ratio transmission level.

The power taken by a given load equals:

$$P_2 = \frac{U_2^2}{R_2}$$

where U_2 - voltage across the load

R_2 - resistance of the load

Power input $P_1 = 0.001$ w corresponds to a voltage $U_1 = 0.775$ V across a resistance $R_1 = 600$ ohms.

On the basis of the above relationships the absolute power-ratio transmission level can be expressed in the following form:

$$P_{AM} = P_{AH} - 20 \log \frac{R_2}{600}$$

When the measurements are to be taken, have in mind that the load resistance is shunted by the instrument and correct readings are obtainable only when the load resistance is considerably lower than that of the instrument.

d/ Measurement of P_{OM} - relative power-ratio transmission level.

The relative power-ratio transmission level P_{OM}, between two points 1 and 2 of a circuit is equal to the difference between the absolute power-ratio transmission levels at each of these points, or:

$$P_{OM} = P_{AM_2} - P_{AM_1}$$

The absolute power-ratio transmission levels, P_{AM_2} and P_{AM_1} at points 1 and 2 are measured as directed above.

e/ Measurement of voltage and power gain.

The voltage gain factor is the same as the relative voltage-ratio transmission level.

The power gain factor, similarly, is none other than the relative power-ratio transmission level.

Measurements of these values are to be taken as instructed above.

6. Measurement of Communication Circuit Attenuation

a/ Measurement of effective attenuation bp

$$bp = 20 \log \frac{U_1}{0.775} = 20 \log \frac{U_2}{0.775} - 10 \log \frac{R_1}{R_2}$$

where: $U_1 = \frac{E_o}{2}$ - voltage across load R_1 directly connected to a generator.

E_o - e.m.f. of generator

U_2 - voltage across load R_2 connected to the generator with the aid of the line under test.

The values $20 \log \frac{U_1}{0.775}$ and $20 \log \frac{U_2}{0.775}$ are the absolute voltage-ratio transmission levels and are to be measured as directed above.

The value of $10 \log \frac{R_1}{R_2}$ is determined by calculation. Note here, that, if the input resistance of the line is equal to the internal resistance of the generator, it is used as load R_1. When this is not so, load R_1 is to be set up by some other means.

To obtain correct results the values of R_1 and R_2 are to be considerably lower than the resistance of the instrument /respectively equal to 3000 ohms on "3 V" range and 7500 ohms on "7.5 V" range/.

b/ Measurement of introduced attenuation b_B

$$b_B = 20 \log \frac{U_1'}{0.775} - 20 \log \frac{U_2}{0.775}$$

where: U_1' - voltage across load R_1 connected directly to a generator

U_2 - voltage across load R_2 connected to the generator through the line under test.

The values $20 \log \frac{U_1'}{0.775}$ and $20 \log \frac{U_2}{0.775}$ are none other than the absolute voltage-ratio transmission levels and are measured accordingly.

To obtain correct results, the value of R_2 should be considerably less than the resistance of the instrument /respectively, 3000 ohms on the "3 V" range and 7500 ohms on the "7.5 V" range/.

Line attenuation measurements are greatly simplified if load R_2 equals 600 ohms and a standard generator with an internal resistance of 600 ohms is employed /Note here that under these conditions the effective attenuation and introduced attenuation are equal -- $b_p = b_B$/.

In such cases it is convenient to use the "db" range of the instrument. As was stated above, the instrument on this range has an internal resistance of 600 ohms and can be employed as load R_2.

Attenuation measurements amount to the following:

Connect the instrument for measurement on the "db" scale /set the operation-mode switch in "~" position and the range-selector switch in the "db" position/.

First connect instrument terminals "-" and "+" directly to the generator terminals with the line disconnected and take the first reading on the "db" scale. Now connect the instrument to the generator through the line under test and take the second reading on the "db" scale.

The attenuation of the line is equal to the difference of the first and second readings.

7. Dry cell replacement

To replace the dry cell, move the small cover on the bottom of the instrument to one side.

After removal of the used cell, insert the new Type ФБС-0.25 cell in its recess with observance of the polarity.

The positive electrode brought out in the center of the cell should be faced in the direction of the "+" mark on one edge of the cell recess.

VII. PERIODIC CHECKS

Check the accuracy of the instrument periodically, not less than once a year, by the methods prescribed in the acting instructions of the Committee of Standards, Measures and Measuring Instruments of the U.S.S.R. Council of Ministers.

The readings on all the current and voltage ranges of the instrument are to be compared with the readings of a laboratory standard instrument of 0.5 class accuracy for the d.c. ranges and 1.0 class accuracy for the a.c. ranges.

Select the laboratory standard instruments so that their full scale values do not exceed the corresponding full scale values of the instrument being checked by more than 25%.

Check the resistance ranges of the instrument with the aid of a decade resistance box connected for this purpose to the instrument. The value to be checked for on the scale is to be set to on the resistance box. The error is directly determined from the reading on the scale of the instrument. The allowable error of the resistance box is not to exceed ±1% of the nominal values.

Checking of the capacitance range is carried out similar to that on the resistance ranges, a capacitance box being employed in place of the resistance box. The allowable error of the capacitance box is not to exceed ±1% of the nominal values for capacitances up to 1 mfd, and ±5% for capacitances up to 10 mfd.

The decibel scale is to be checked by design voltages in accordance with the Table below.

Decibel scale division to be checked	-10	-5	0	+5	+10	+12
Voltage to be applied to instrument terminals, volts	0.245	0.436	0.775	1.38	2.45	3.03

To check the instrument, arrange it for "db" readings and apply the voltages given in the Table to its terminals.

The errors in the readings are determined directly from the readings taken on the instrument.

VIII. STORAGE

These instruments are to be stored in closed rooms at temperatures ranging from +10° to +35°C and a relative humidity below 80%. The air in the room should be free of corrosive fumes or vapours.

IX. CHARACTERISTIC FAULTS AND THEIR METHODS OF REMEDY

The following most common faults may be found to occur during service of the instrument: broken resistor connection, broken connection of ohmeter zero-corrector rheostat, dirty inter-contact spaces in the range-selector switch, deposits of metallic dust due to wear of the brushes and failure of a germanium rectifier.

A broken resistor connection is easily detected by failure to obtain a reading on the corresponding voltage range. A broken rheostat connection results in failure to

btain readings on the current ranges and on all a.c. voltage anges /the d.c. voltage readings will have an accuracy within 10%/.

A broken resistor connection in the universal shunt /positions 1-10, 40, 11, 12, 14, 15/ will lead to approximately the same results as a broken connection in the rheostat circuit. Soiled inter-contact spaces in the range-selector switch result in obtaining of the same indications on several ranges, /for example the 150-, 300- and 600-volt ranges/, when one and the same voltage is applied to the instrument.

Failure of the germanium rectifiers is detected when false readings are obtained on all the a.c. current and voltage ranges and correct readings are obtained on the d.c. current and voltage ranges. To find the faulty components it is convenient to refer to the elementary circuit diagram of the instrument /see appendix/.

To remedy these defects the instrument is to be opened. For this remove the four screws which secure the bottom of the casing and remove the bottom. Now back out the three screws opposite the terminals and the two screws on the opposite side of the casing. Take out the panel on which all the circuit components are assembled. When this is being done, the terminals and the range-selector switch knob remain on the casing.

With the aid of the wiring diagram and the numbering of the instrument components, any desired component is easily located on the panel. Defects are detected by visual inspection and by approximate measurements, for example, with an instrument of similar type. Questionable components are to be removed and thoroughly inspected. Defective parts are either

repaired or replaced.

When the instrument is open, protect it against dust and dirt.

After repairs which involve changes in the parameters of the instrument /for example, after replacement of germanium rectifiers, rewinding of the moving coil, etc./, the instrument is to be partly or fully adjusted. Below are given all the operations carried out for full adjustment. Depending upon the nature of the repairs, the adjustment can be commenced at one or another stage with observance of the following sequence /in the description of the operations given below, the numbers enclosed in parentheses coincide with the numbers on the wiring diagram, in the specification and in the instrument/.

1/ All the resistances, with the exception of the adjusting resistances /18, 19, 22, 14, 15/ and capacitors /58 to 61/, are to be adjusted to the values given in the specification.

2/ If the microammeter was repaired, adjust it so that full scale deflection of the pointer corresponds to a current of 15 microamp, passed through the moving coil.

When this is done, the resistance of the moving coil is not to exceed 490 ohms at a temperature of +20°C.

/Generally speaking, the instrument will likewise operate in cases when the moving coil has a resistance up to 600 ohms.

The temperature error on the 75 mV scale will, however, exceed permissible value and will be equal to approximately 1.8% for each 10°C change in temperature./

The beginning and end of each scale is to be marked with a dot.

3/ Adjust the total resistance of microammeter /50/ and resistor /14/ to 600±3 ohms at a temperature of +20°C. If the adjustment is carried out at a temperature other than +20°C, the value of the resistance to be obtained when adjusting can be determined by calculation with the aid of the following formula:

$$R_{50} + R_{11} = 600 + 1.8\ (t-20)\ \pm 3 \text{ ohms}$$

where t - temperature at which adjustment is made.

4/ Adjust the sum of resistances /15/ and /16/ to 2000±4 ohms /resistance 16 - ohmmeter zero-corrector rheostat/.

5/ Switch the instrument to one of the higher a.c. voltage ranges /150, 300 or 600 volts/ and connect it to a 50-cycle a.c. voltage, and, with the aid of a laboratory standard voltmeter, set the voltage to the full scale value of the range selected.

Now adjust resistance /19/ such that the microammeter pointer will indicate full scale value under the above conditions.

6/ Switch the instrument over to the 15 V a.c. voltage range, connect it to a 50-cycle a.c. voltage source and, with the aid of a laboratory standard voltmeter, set the voltage to 15 volts on the terminals of the instrument under test.

Now adjust resistance /22/ so that the microammeter pointer, under these conditions gives a full scale readin

7/ Switch the instrument over to any one of the alternating current ranges and connect it to a 50-cycle a.c. source and, with the aid of a laboratory standard ammeter, adjust for a current corresponding to full scale value of the selected range.

Resistance 18 is now to be adjusted so that the pointer of the microammeter gives a full scale deflection under the above conditions.

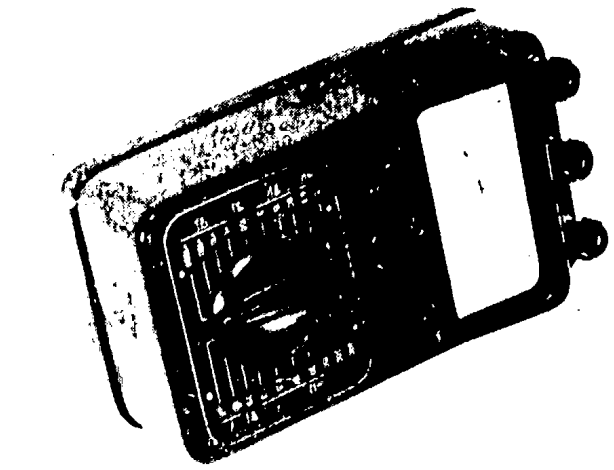
The above operation is the last adjustment to be made. On completion of the adjustments check the full scale deflection on all the ranges of d.c. and a.c. voltage and current for accurate coincidence with the full scale divisions. Also check the resistance and capacitance ranges.

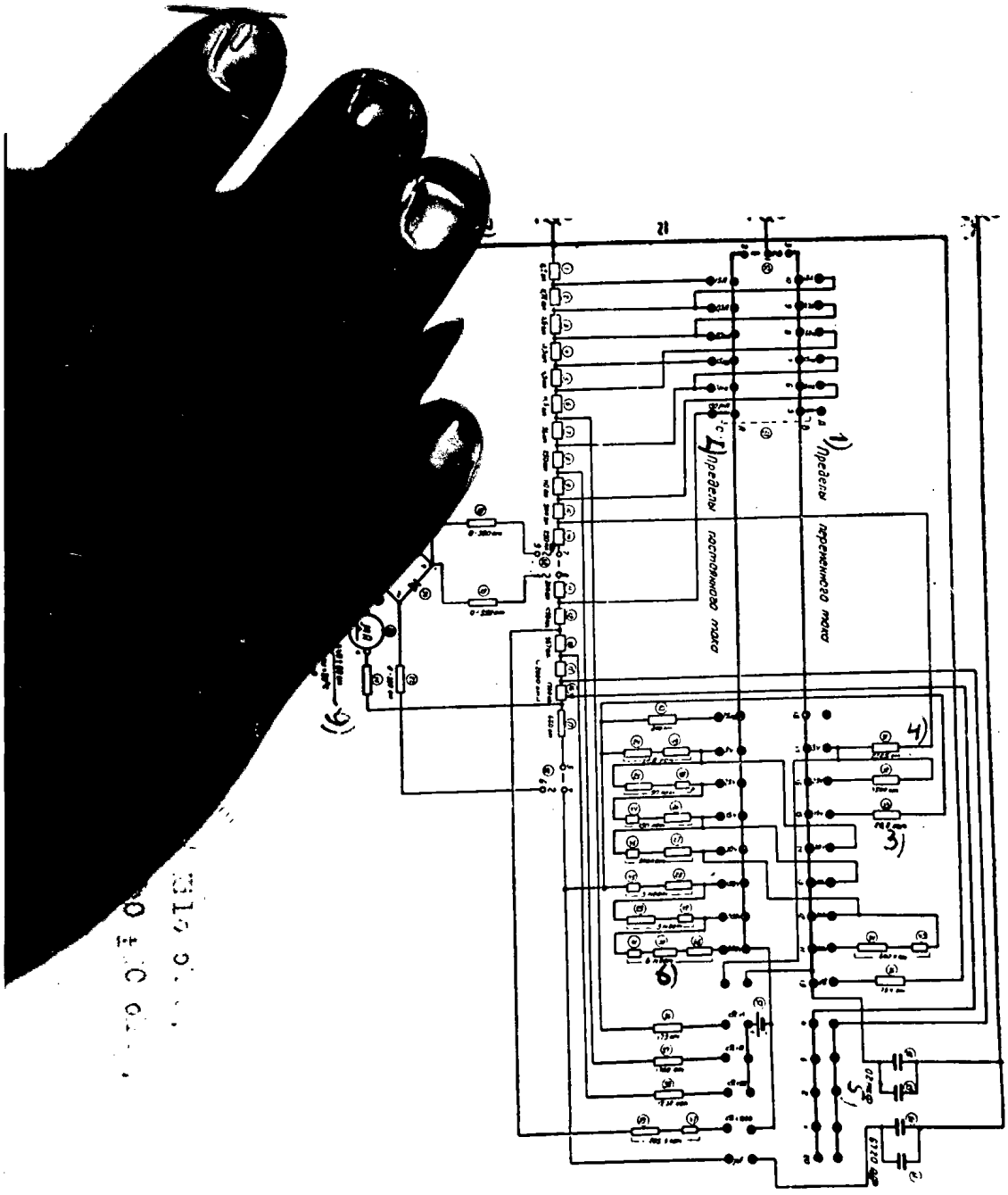
X. APPENDICES

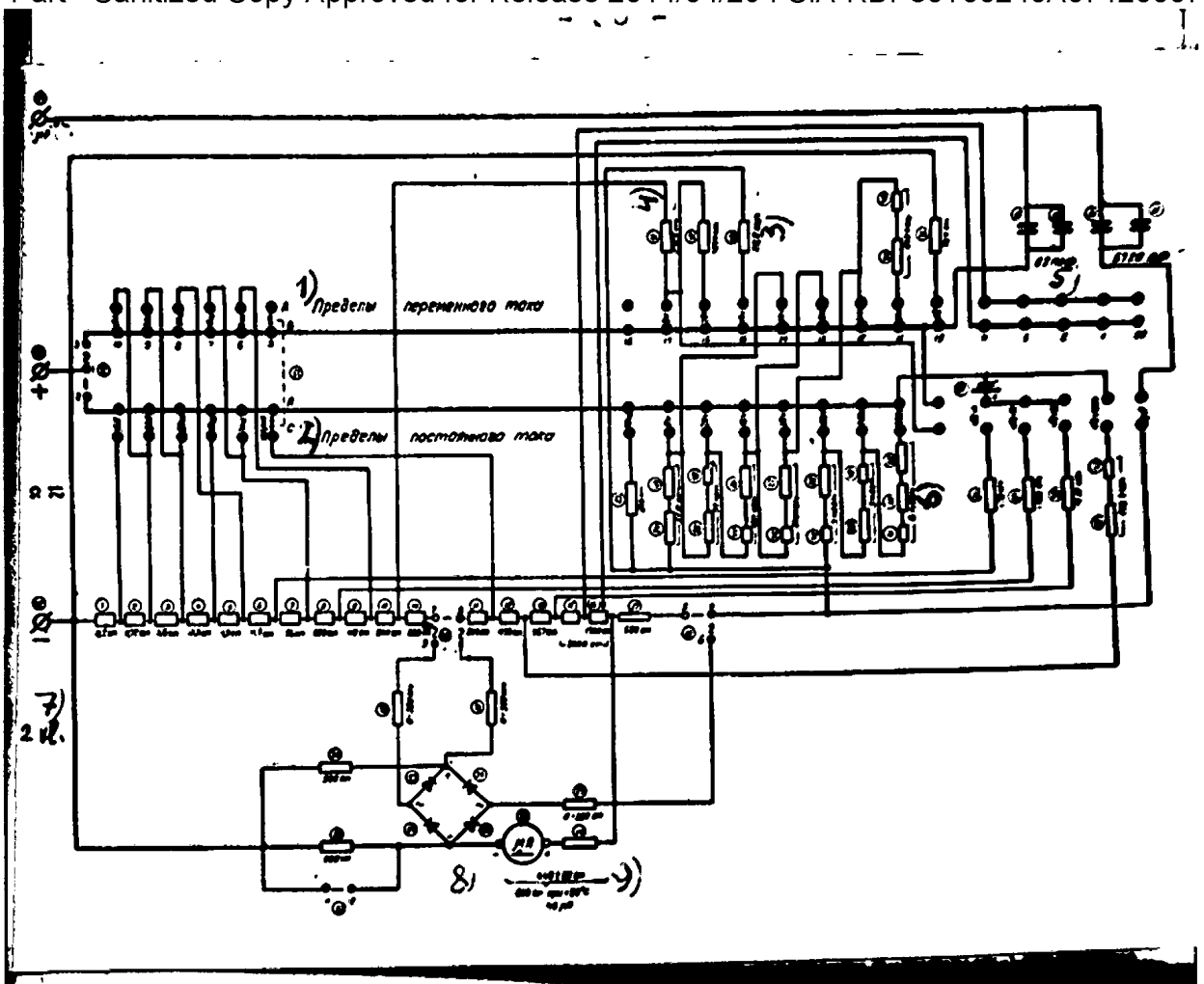
The present Description and Instruction include:

1. Elementary circuit diagram.
2. Wiring diagram and specifications.

The numbering of the circuit components is idential on the elementary circuit diagram, wiring diagram, and in the instrument proper.

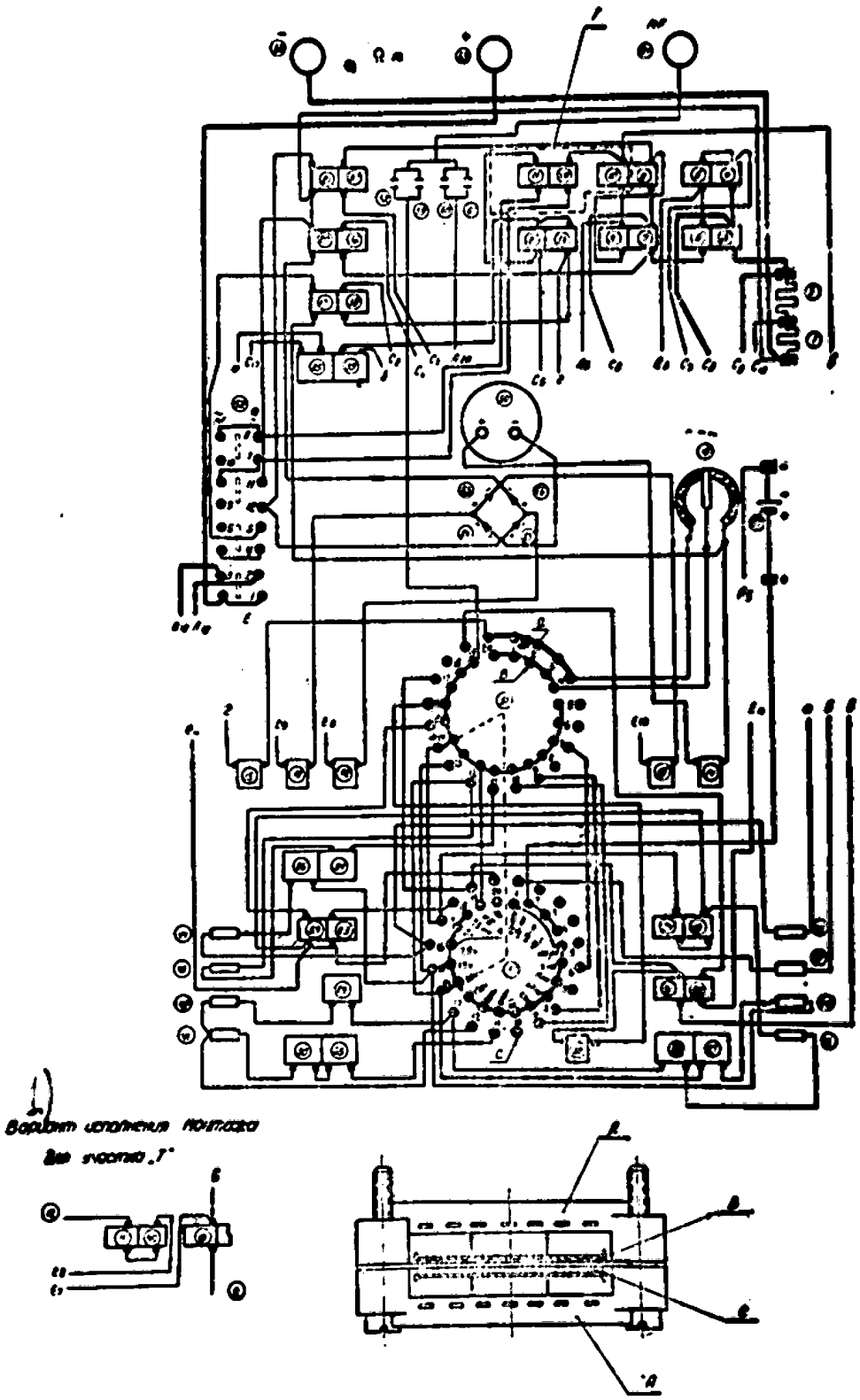






Elementary circuit diagram.

1/ A.c. side; 2/ d.c. side; 3/ Kilo ohms; 4/ Ohms; 5/ mfd; 6/ megohms; 7/ kV; 8/ mA; 9/ 4.0 ± 0.0 ohms; 600 ohms at +20°C; 45 mA.



Wiring diagram

1/ Alternative wiring for section "T"

The [illegible] the correction may be [illegible] dance with the alternative wiring [illegible] section "T" on the wiring diagram.

Specification

Circuit Number- ing	Code designation	Name	Quan- tity	Rating	Tol.
1	[illegible]273.013	Resistor	1	0.1±0.0001 ohms	
2	[illegible]273.019	"	1	0.72± .002 ohms	
3	[illegible] 20.[illegible]62	Coil	1	3.1± .007 ohms	
4	[illegible] 20.[illegible]25	"	1	16.[illegible].027 ohms	
5	[illegible] 20.[illegible]26	"	1	4.[illegible].00 ohms	
6	[illegible]20.[illegible]17	"	1	71.[illegible].12 ohms	
7	[illegible]31.[illegible]3	"	1	[illegible].11 ohms	
8	[illegible]320.[illegible]4	"	1	[illegible] ohms	
9	[illegible]30.[illegible]13	"	1	1[illegible]±.22 ohms	
10	[illegible]2[illegible].372	"	1	[illegible].8 ohms	
11	[illegible] 30.[illegible]	"	1	20[illegible].4 ohms	
12	[illegible] [illegible]	"	1	[illegible]±.2 ohms	
13	[illegible] 30.[illegible]45	"	1	[illegible].1 ohms	
14	[illegible] 30.[illegible]49	"	1	[illegible]± ohms	or adjustment
15	[illegible] 30.[illegible]47	"	1	120±30 ohms	Total resistance of [illegible]
16	[illegible]273.021	"	1	1700±100 ohms	[illegible] 2000± ohms
17	[illegible] 30.[illegible]11	"	1	[illegible].8 ohms	
18	[illegible]30.[illegible]2	"	1	800±10 ohms	or adjustment

(See continuation)

1	2	3	4	5	6
19	5ПД.520.350	Coil	1	350±10 ohms	For adjustment
20	5ПД.520.350	"	1	590±1.1 ohms	
21	5ПД.520.350	"	1	590±1.1 ohms	
22	5ПД.520.349	"	1	350±10 ohms	For adjustment
23	5ПД.520.351	"	1	300±0.6 ohms	
24	5ПД.520.339	"	1	29400±58 ohms	
25	6ПД.273.035	Resistor type P 701 a	1	0.09 megohms	Total resist. of 25 and 48; 90±0.18 kiloohms
26	6ПД.273.034	"	1	0.15 megohms	Total resist. of 26 and 44; 150±0.3 kiloohms
27	6ПД.273.031	"	1	0.3 megohms	Total resist. of 27 and 46; 300±0.6 kiloohms
28	6ПД.273.028	" "	1	3 megohms	Total resist. of 28 and 45; 3000±6 kiloohms
29	6ПД.273.028	"	1	3 megohms	"
30	6ПД.273.028	"	1	3 megohms	Total resist. of 30,65 and 41 - 6000±12 kiloohms
31	5ПД.520.356	Coil	1	2325±4.6 ohms	
32	5ПД.520.357	"	1	4500±9 ohms	
33	5ПД.520.334	"	1	28800±57 ohms	
34	6ПД.273.030	Resistor type 701a	1	0.6 megohms	Total resist. of 34 and 43; 600±1.2 kiloohms
35	5ПД.520.352	Coil	1	750±1.5 ohms	
36	5ПД.520.353	"	1	175±0.34 ohms	

1	2	3	4	5	6
37	5ПД.520.358	Coil	1	1750±3.5 ohms	
38	5ПД.520.335	"	1	19520±40 ohms	
39	6ПД.273.033	Resistor, type 701a	1	0.2055 megohms	Total resist. of 39 and 205.5±0.4 kiloohms
40	5ПД.520.344	Coil	1	250±5 ohms	
41	Resistor BC-0.25-1 ГОСТ 6562-53		1		Adjusting resistor for resistor 30
42	Resistor BC-0.25-1 ГОСТ 6562-53		1		Adjusting resistor for resistor 29
43	Resistor BC-0.25-1 ГОСТ 6562-53		1		Adjusting resistor for resistor 34
44	Resistor BC-0.25-1 ГОСТ 6562-53		1		Adjusting resistor for resistor 26
45	Resistor BC-0.25-1 ГОСТ 6562-53				Adjusting resistor for resistor 28
46	Resistor BC-0.25-1 ГОСТ 6562-53		1		Adjusting resistor for resistor 27
47	Resistor BC-0.25-1 ГОСТ 6562-53		1		Adjusting resistor for resistor 39
48	Resistor BC-0.25-1 ГОСТ 6562-53		1		Adjusting resistor for resistor 25
49	5ПД.520.339	Coil	1	29400±58 ohms	
50		Measuring movement	1	45 Microamp. 440±60 ohms	Total resist. of 50 and 14 60±3 ohms at 20°C

1	2	3	4	5	6
51	6П4.264.021	Switch	1		Switch panels A, B, D
52	6П4.264.021	Switch	1		
53	Germanium diode	ГД-10 spec.TY No.232-53	1		Replacement by ГД-9 possible
54		-"-	1		-"-
55		-"-	1		-"-
56		-"-	1		-"-
57	Type БГС-А-0.25	spec.TY No.12-50	1		
58	Capacitor БГ-2-400-0.1-11;	ГОСТ 5115-52	2		Total capacitance of capacitors 55 and 58: 0.2±0.02 mfd
59	Capacitor КЗ05.00,	ГОСТ 5119-54	1		for adjustment of 58
60	Capacitor КЗ0-5-500-Г-6200-11;	ГОСТ 5119-54	1		Total capacitance of capacitors 60 and 61; 6200±.2 mmf.
61	Capacitor КЗ0-2-500-	ГОСТ 5115-52			for adjustment of 60
62		Terminal			
63		Terminal			
64		Terminal			
65	2П4.275.025	Resistor type 2 Watts	1	5 megohms	

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1-HUM

Attachment

S-E-C-R-E-T
NO FOREIGN DISSEM

GROUP 1
Excluded from automatic downgrading and declassification

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